

# M1 – Objectives and Key Facts

## a) Estimate, measure and construct lengths accurately

You should be able to measure distances/lengths fairly accurately using a ruler and using a tape measure.

## b) Tell how accurate a measurement is

If we say the length of something is  $56.2 \text{ mm} \pm 2\text{mm}$ , we mean that we are fairly sure that its length lies within 2 mm of 56.2 mm, ie. that its length is between 56.0 mm and 56.4 mm inclusive. The  $\pm 2\text{mm}$  is called the confidence interval. The more accurately we can measure something, the smaller the confidence interval.

## c) Convert between mm, cm, m and km

The metre is the basic unit of length. A metre is a long pace. Other units are made by adding prefixes – *milli-* means thousandth, *centi-* means hundredth, *kilo-* means thousand.

So  $10 \text{ mm} = 1 \text{ cm}$ ,  $100 \text{ cm} = 1 \text{ m}$  and  $1000 \text{ m} = 1 \text{ km}$ .

To convert, multiply or divide by 10, 100 or 1000 accordingly. If you are converting to a smaller unit, there will be more of them, so multiply. If you are converting to a larger unit, there will be less of them, so divide. Always check to see that your length seems to be about the same size in the original and the new units.

## d) Measure and calculate perimeters of polygons

Perimeter is the length of the edge of a shape. If the edge is made up of a number of lines, measure each line then add the measurements. If the lengths of the lines are given for you, just use these.

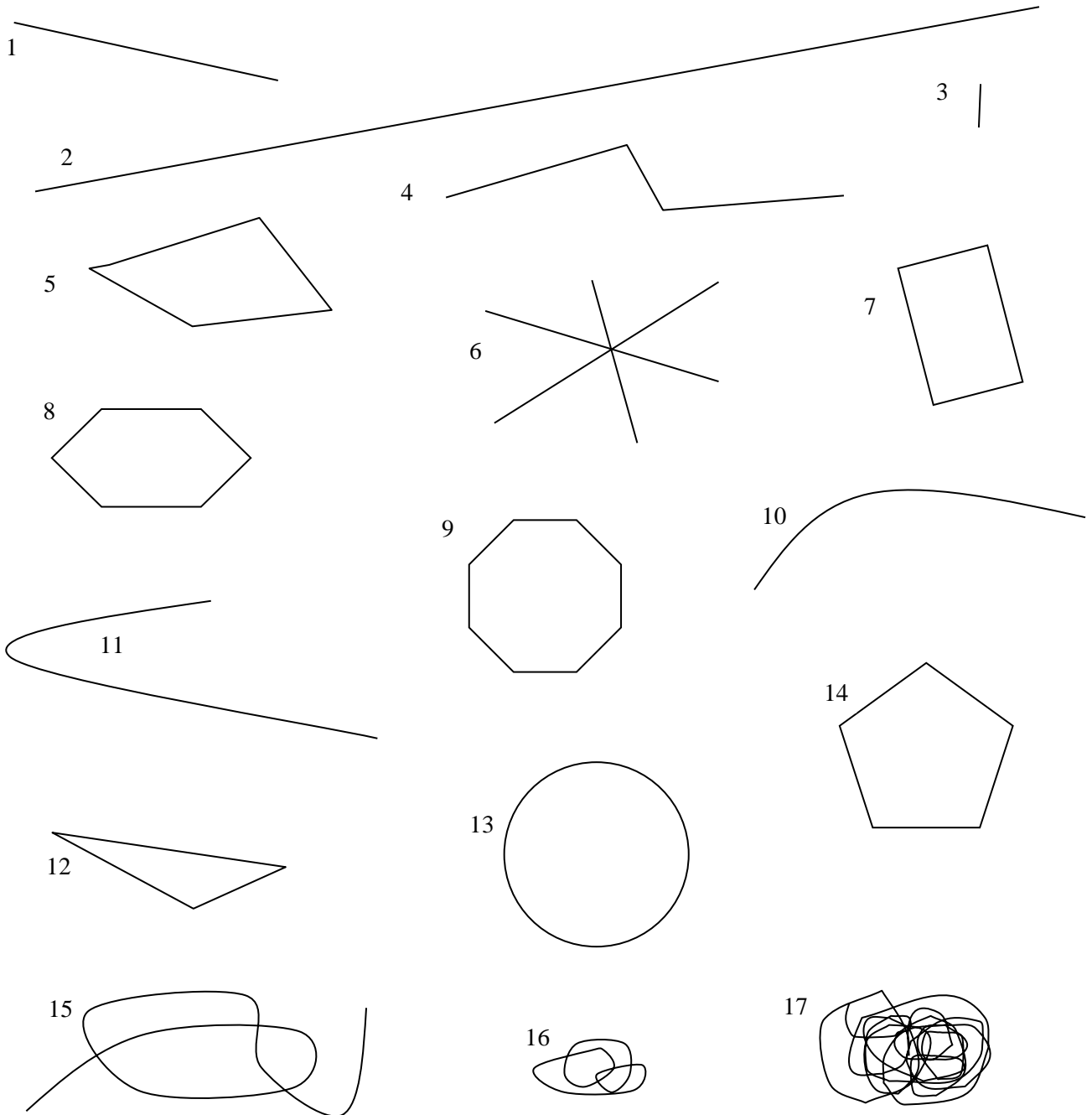
## e) Calculate circumference of circles

The perimeter of a circle is called its circumference. The circumference of a circle can be calculated by multiplying its diameter (width) by 3, or to be more accurate, 3.14. This number is called  $\pi$  (pi). To be even more accurate,  $\pi = 3.141592654 \dots$  If you have a scientific calculator, it will have a button that will give you an accurate value of  $\pi$ .

# MEASURING AND CONSTRUCTING LENGTHS

Find the length of line in each of the following drawings. Write down the length in millimetres and in centimetres.

Also write down the possible error. For instance  $78 \text{ mm} \pm 2 \text{ mm}$  says that the line seems to be 78 mm long, but that it could be up to 2 mm either side (ie. 76 mm to 80 mm). It is easy to measure single straight lines fairly accurately, so the errors for the first couple will be small (maybe  $\pm 1 \text{ mm}$ ), but for some of the others, it is much more difficult to get an accurate measurement and the error will therefore be much larger (maybe  $\pm 10 \text{ mm}$ ).



Draw lines with the following lengths and let your partner check them for accuracy.

- (a) 62 mm, (b) 9 mm, (c) 3.4 cm, (d) 13.8 cm, (e) 8 cm, (f) 150 mm, (g) 29.3 mm, (h) 7.25 cm.

# LENGTH CONVERSIONS

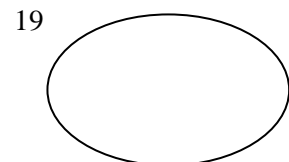
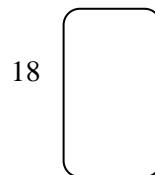
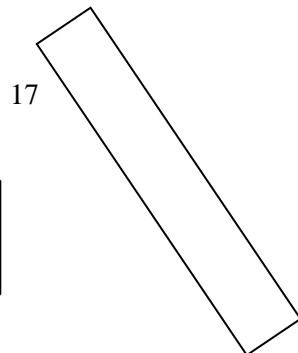
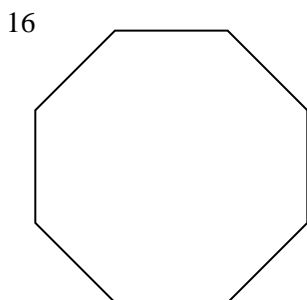
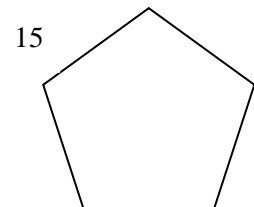
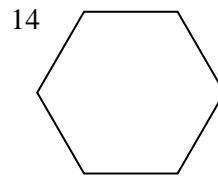
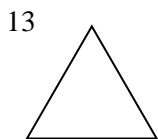
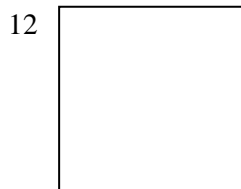
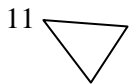
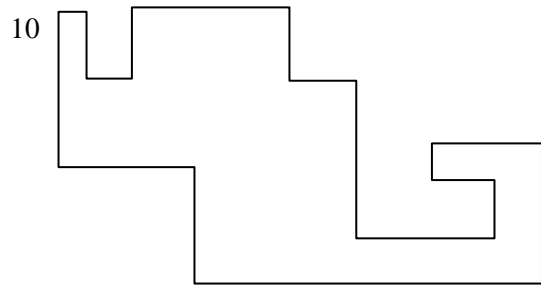
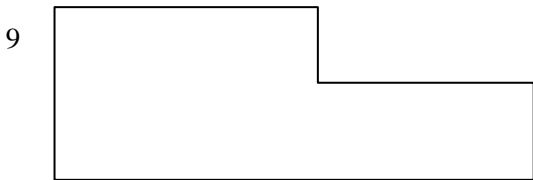
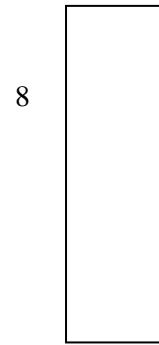
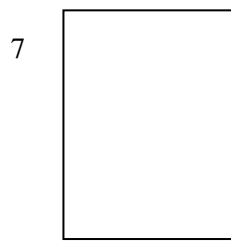
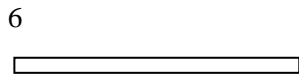
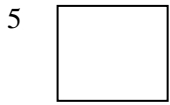
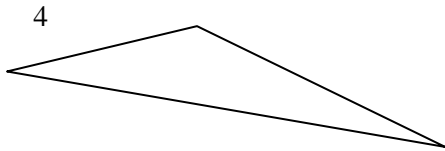
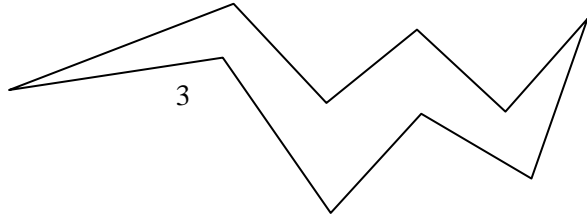
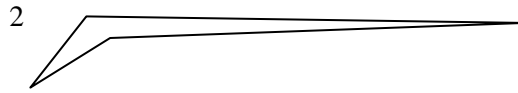
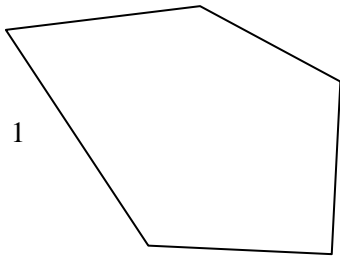
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|--|--|
| 1. Write 120 mm in centimetres . . . . . | 9. Write 0.45 km in metres. . . . .      |
| 2. Write 2 cm in millimetres. . . . .    | 10. Write 1.7 mm in centimetres. . . . . |
| 3. Write 14.5 cm in millimetres. . . . . | 11. Write 180 cm in metres. . . . .      |
| 4. Write 4 m in centimetres. . . . .     | 12. Write 600 mm in centimetres. . . . . |
| 5. Write 2.3 m in millimetres. . . . .   | 13. Write 150 cm in millimetres. . . . . |
| 6. Write 2 km in metres. . . . .         | 14. Write 2.6 mm in metres. . . . .      |
| 7. Write 6000 m in kilometres. . . . .   | 15. Write 0.2674 km in metres. . . . .   |
| 8. Write 680 m in kilometres. . . . .    | 16. Write 194.3 m in kilometres. . . . . |

Complete the following table:

mm	cm	m	km
	28		
		4.2	
6000			
			1
	450		
		0.25	
47			
			0.0006
	7.5		
		300	
900 000			
			6.92
	0.1		
		17	
4.5			
			0.0237

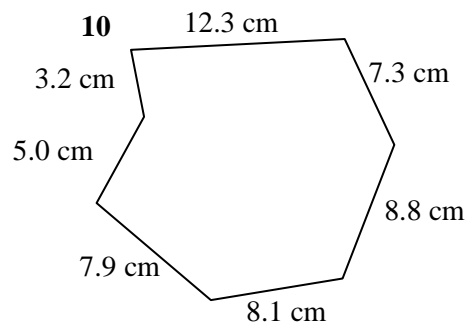
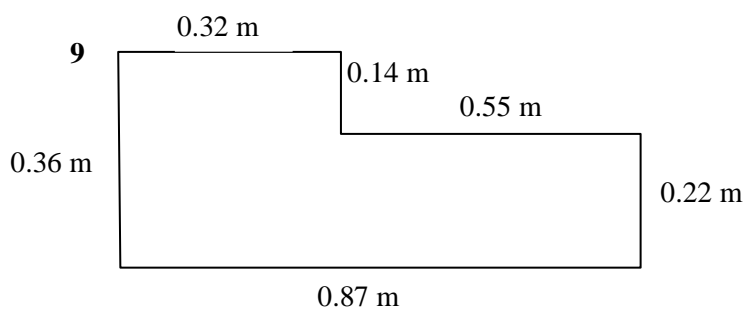
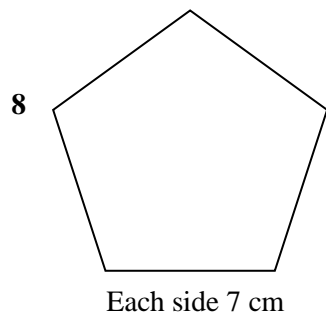
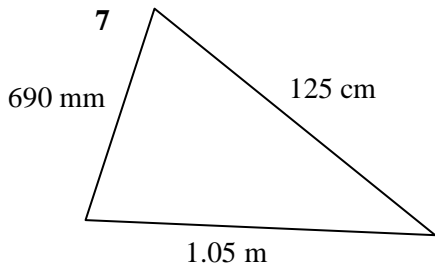
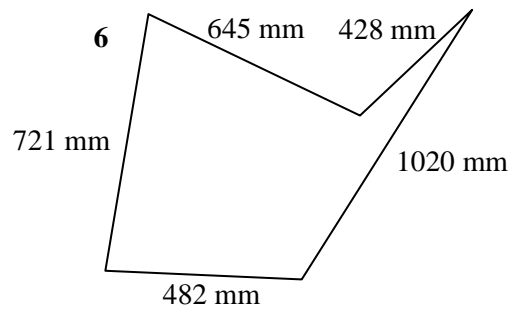
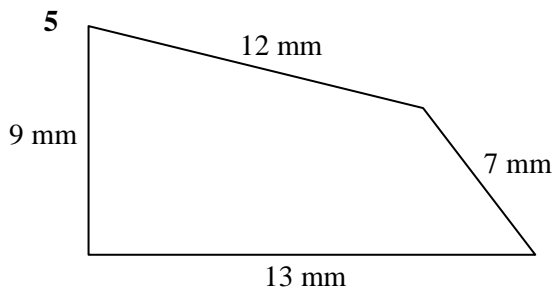
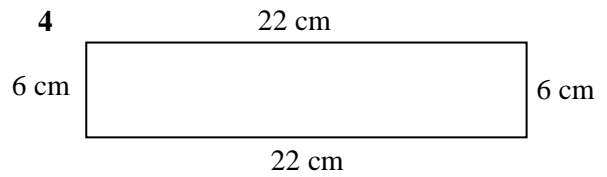
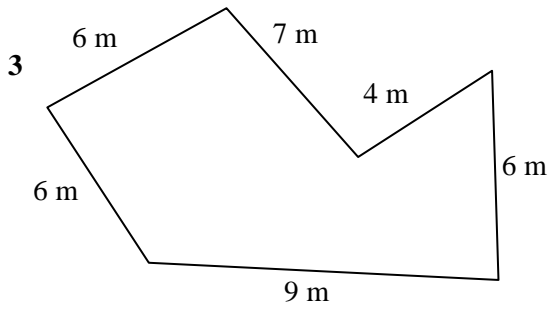
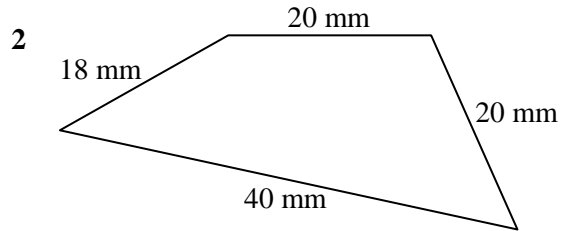
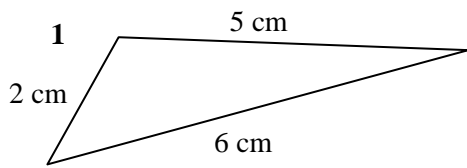
# PERIMETERS 1

Find the perimeters of these shapes. Give your answers in millimetres, in centimetres and in metres.



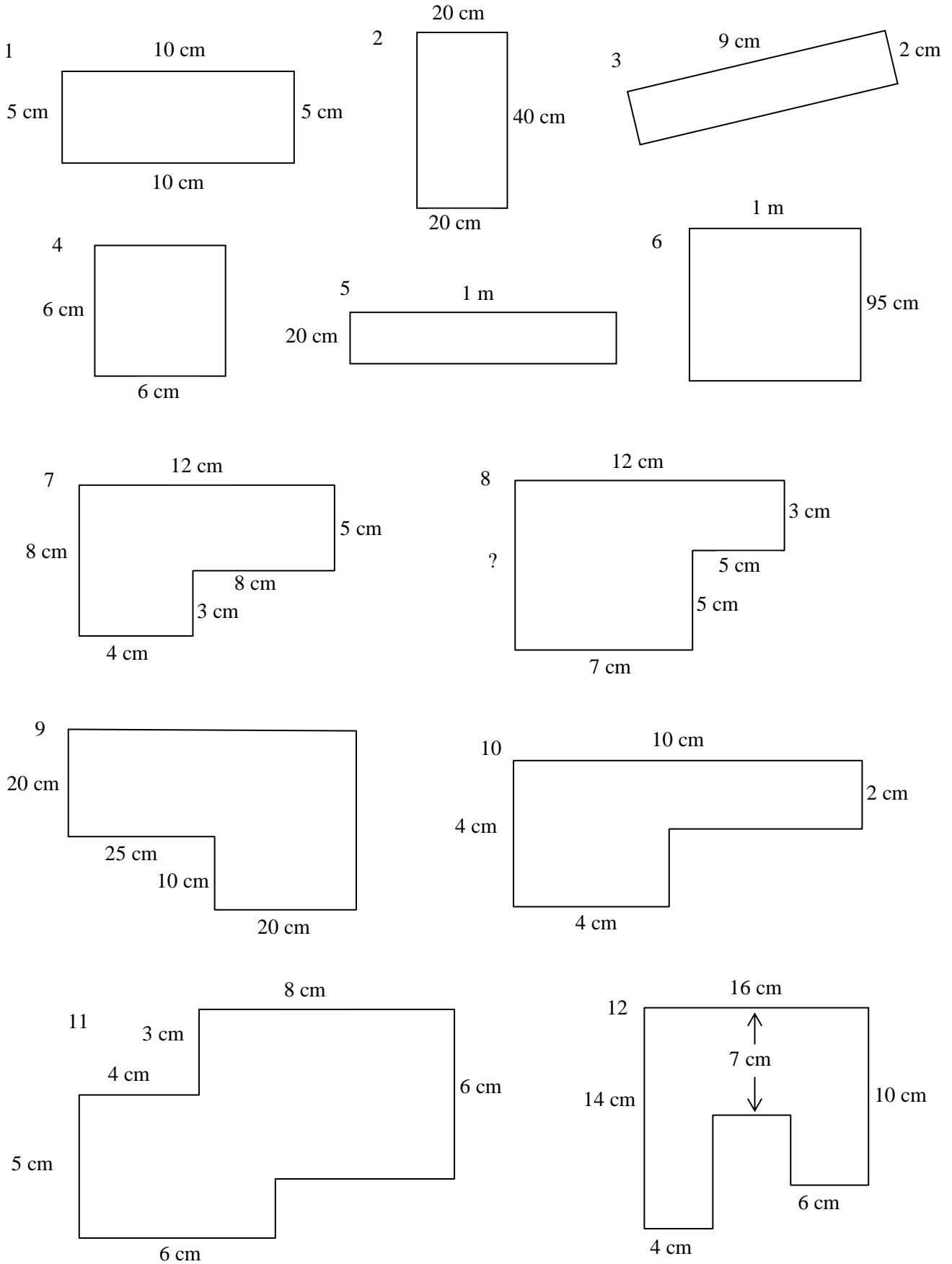
# PERIMETERS 2

Find the perimeters of the following shapes (not drawn to scale) using the measurements given. Write your answers in mm, cm and m.



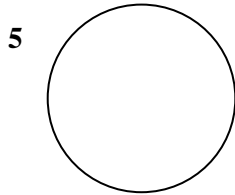
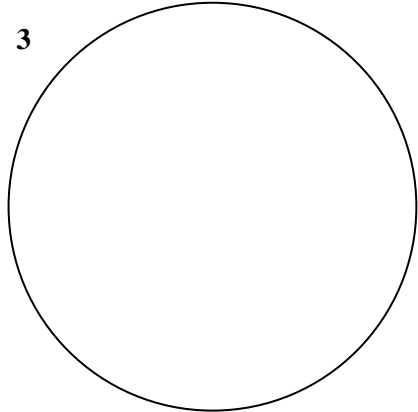
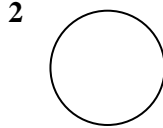
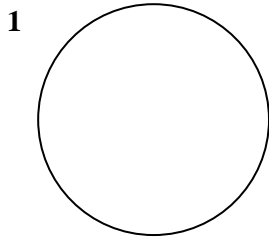
# PERIMETERS 3

Find the perimeters of the following shapes in centimetres. You may assume that all angles that look like right angles are right angles.

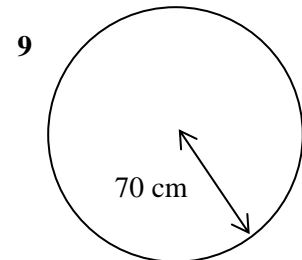
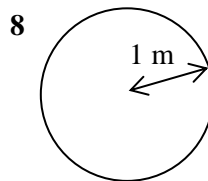
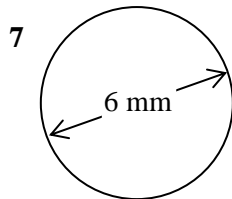
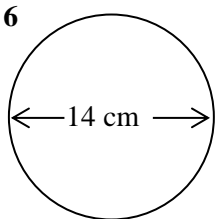


# PERIMETERS 4

Find the circumference of these circles by measuring their diameters.



Find the circumference of these circles using the diameters and radii given.



10 Find the circumference of circles with the following diameters:

- (a) 5 cm    (b) 2 m    (c) 48 mm    (d) 17 km

11 Find the circumference of circles with the following radii:

- (a) 8 cm    (b) 10 m    (c) 5 mm    (d) 1 km

12 Imagine a metal band were wrapped tightly around the equator. It would be 40 000 km long. Then imagine that someone cut it and inserted an extra metre. Being longer, it would no longer be tight, but there would be a gap between the ground and the band. Suppose that the band was held so that the gap was the same all the way round the earth. How big would the gap be?

# TEACHER NOTES

## Measuring and constructing lengths

### Activity 1

Give students practice at measuring lines on paper with a ruler. Make sure they know to start at the zero on the ruler. Use the *Measuring and Constructing Lengths* worksheet. See that students can measure in mm and cm accurate to 0.1cm. Discuss appropriate units for measurement. Mention that cm are not used in the trades or engineering work. Explain to students that they should avoid mixed units, eg. 12 cm 6 mm.

Discuss accuracy, eg. if a piece of wood is 50 mm long, is one seventh of it 7.142857 mm long?

### Activity 2

Show students how to use a metre ruler, a 30 m tape and a trundle wheel. Then write a dozen or so lengths/distances on the board for them to measure. Examples might be:

- the length of their desk tops
- the thickness of their desk tops
- the height of the glass panes in the windows
- the length of the port racks
- the length of the building
- the distance to a specified tree

Get them to work in pairs so that discussion and checking can take place. Compare results afterwards.

## Estimating Length

Get students to measure a set of lengths/distances similar to those in the last activity, but, this time, get them to estimate them first. A good way is to work in pairs; both people draw up a table like the one below in their books; then they estimate and write the estimates in their tables .

Thing being measured	Kim's Estimate	Peta's Estimate	Measurement	Winner

They then make the measurement and see who is closest.

## Body Parts

Explain the value of knowing the length of parts of one's body (besides for boosting one's ego). [A good demonstration of this is to ask a student to put a spot on the board a whole number of centimetres from one end while you are out of the room, then come back in and measure the distance without any measuring implements].

Students should determine and record their own hand span and find a finger whose width (side to side or front to back is 1 cm).



Then get them to measure a few things around the classroom this way and to check the accuracy of each measurement by repeating it with a ruler. You could have some sort of competition to see who can give the most accurate finger measurement of say the width of the door.

## **Estimating and pacing outdoor lengths**

Take students outside for some distance estimation and pacing practice.

Get the students to get a feel for a 1m pace. This can be done by placing two sticks on the ground outside the classroom 10m apart and getting students to pace the distance until they can do it reliably in exactly 10 paces.

Then ask them to walk a given distance from where you are towards some distant landmark and stop. Come behind them with a trundle wheel; stop at the exact distance so that students can see how accurate they were and whether they were under or over. Repeat this a few times. They should get progressively better – hopefully!

Then ask them to estimate the distance to some feature, and then to pace it. Then measure with the trundle wheel so they can see how they went. Repeat a few times.

## **Converting between millimetres, centimetres, metres and kilometres**

Discuss the meaning of the term *metre* (one ten millionth of the distance from the pole to the equator). Then discuss the meaning of the pre-fixes *milli-*, *centi-* and *kilo-*.

Explain how to convert between mm, cm, m and km. [If you have not done Unit N1, Objective j, then you will probably need to explain how to multiply and divide by 10, 100, 1000 etc or let them use their calculators.]

Then give some practice (oral and written from the board) doing conversions.

Then get them to do the *Length Conversions* worksheet in the Students' Booklet.

## **Perimeters of polygons**

Explain perimeters, then get students to work through the three perimeters worksheets in the Students' Booklet.

## **Circumference of Circles**

One way to teach this is through the following activity.

Get a collection of round objects of a range of sizes and a tape measure. Measure the diameter of the first, then ask the students to estimate the circumference. [Ask that if anyone knows how to do it, they keep the fact to themselves, though they can still put in their estimates.] Put the diameter and some of the circumference estimates on the board if you like. Then measure the circumference.

Next choose an object of a different size and repeat the procedure, then again and again etc.

Students should firstly see that you can generally get the circumference roughly by multiplying by 3. Then they should see that it is generally a little more than 3 times the diameter. Discuss these observations as you proceed, but after most students have made them for themselves.

Ask for the students' opinions on whether the number you multiply by would be the same for all circles and let them discuss this. Finally point out that the number is 3.141 592 653 589 79... (going on for ever). Point out that

scientific calculators have an approximation to 8 or 10 places built in and get them to explore it. Tell them that 3.14 is a reasonable approximation if they don't have the more accurate value handy and that for many purposes 3 will do.

Then get them to calculate the circumference of a few circles, given diameters. Make sure they understand that radius is half the diameter and get them to work out some circumferences from radii. Don't introduce the  $2\pi r$  method, though - stick to 'diameter  $\times \pi$ '.

Get the students to do the circumference worksheet.

## ANSWERS

### MEASURING AND CONSTRUCTING LENGTHS (Approximate answers)

1	43 mm	4.3 cm	$\pm 1$ mm
2	162 mm	16.2 cm	$\pm 1$ mm
3	7 mm	0.7 cm	$\pm 1$ mm
4	71 mm	7.1 cm	$\pm 2$ mm
5	89 mm	8.9 cm	$\pm 2$ mm
6	107 mm	10.7 cm	$\pm 2$ mm
7	75 mm	7.5 cm	$\pm 2$ mm
8	76 mm	7.6 cm	$\pm 3$ mm
9	80 mm	8.0 cm	$\pm 4$ mm
10	54 mm	5.4 cm	$\pm 5$ mm
11	97 mm	9.7 cm	$\pm 5$ mm
12	79 mm	7.9 cm	$\pm 2$ mm
13	91 mm	9.1 cm	$\pm 7$ mm
14	85 mm	8.5 cm	$\pm 3$ mm
15	180 mm	18.0 cm	$\pm 10$ mm
16	90 mm	9.0 cm	$\pm 15$ mm
17	500 mm	50 cm	$\pm 300$ mm

### LENGTH CONVERSIONS

- |             |              |             |               |
|-------------|--------------|-------------|---------------|
| 1. 12 cm    | 2. 20 mm     | 3. 145 mm   | 4. 400 cm     |
| 5. 2300 mm  | 6. 2000 m    | 7. 6 km     | 8. 0.68 km    |
| 9. 450 m    | 10. 0.17 cm  | 11. 1.8 m   | 12. 60 cm     |
| 13. 1500 mm | 14. 0.0026 m | 15. 267.4 m | 16. 0.1943 km |

mm	cm	m	km
280	<b>28</b>	0.28	0.000 28
4200	420	<b>4.2</b>	0.0042
<b>6000</b>	600	6	0.006
1 000 000	100 000	1000	<b>1</b>
4500	<b>450</b>	4.5	0.0045
250	25	<b>0.25</b>	0.000 25
<b>47</b>	4.7	0.047	0.000 047

600	60	0.6	<b>0.0006</b>
75	<b>7.5</b>	0.075	0.000 075
300 000	30 000	<b>300</b>	0.3
<b>900 000</b>	90 000	900	0.9
6 920 000	692 000	6920	<b>6.92</b>
1	<b>0.1</b>	0.001	0.000 001
17 000	1700	<b>17</b>	0.017
<b>4.5</b>	0.45	0.0045	0.000 004 5
23 700	2370	23.7	<b>0.0237</b>

### PERIMETERS 1

1	126 mm	12.6 cm	0.126 m	± 3 mm
2	135 mm	13.5 cm	0.135 m	± 3 mm
3	205 mm	20.5 cm	0.205 m	± 5 mm
4	123 mm	12.3 cm	0.123 m	± 2 mm
5	54 mm	5.4 cm	0.054 m	± 2 mm
6	80 mm	8.0 cm	0.080 m	± 2 mm
7	107 mm	10.7 cm	0.107 m	± 2 mm
8	116 mm	11.6 cm	0.116 m	± 2 mm
9	174 mm	17.4 cm	0.174 m	± 3 mm
10	265 mm	26.5 cm	0.265 m	± 8 mm
11	32 mm	3.2 cm	0.032 m	± 2 mm
12	98 mm	9.8 cm	0.098 m	± 2 mm
13	38 mm	3.8 cm	0.038 m	± 2 mm
14	78 mm	7.8 cm	0.078 m	± 3 mm
15	90 mm	9.0 cm	0.090 m	± 3 mm
16	120 mm	12.0 cm	0.120 m	± 4 mm
17	117 mm	1.17 cm	0.117 m	± 2 mm
18	66 mm	6.6 cm	0.066 m	± 6 mm
19	87 mm	8.7 cm	0.087 m	± 10 mm

### PERIMETERS 2

1	130 mm	13 cm	0.13 m
2	98 mm	9.8 cm	0.098 m
3	38 000 mm	3800 cm	38 m
4	560 mm	56 cm	0.56 m
5	41 mm	4.1 cm	0.041 m
6	3296 mm	329.6 cm	3.296 m
7	2990 mm	299 cm	2.99 m
8	350 mm	35 cm	0.35 m
9	2460 mm	246 cm	2.46 m
10	526 mm	52.6 cm	0.526 m

### PERIMETERS 3

- |           |           |           |           |
|-----------|-----------|-----------|-----------|
| 1. 30 cm  | 2. 120 cm | 3. 22 cm  | 4. 24 cm  |
| 5. 240 cm | 6. 390 cm | 7. 40 cm  | 8. 40 cm  |
| 9. 150 cm | 10. 28 cm | 11. 40 cm | 12. 66 cm |

#### **PERIMETERS 4**

- |                 |             |               |              |
|-----------------|-------------|---------------|--------------|
| 1. 19.7 cm      | 2. 4.7 cm   | 3. 17.0 cm    | 4. 1.3 cm    |
| 5. 7.9 cm       | 6. 43.96 cm | 7. 18.84 mm   | 8. 6.28 m    |
| 9. 219.8 cm     |             |               |              |
| 10 (a) 15.7 cm  | (b) 6.28 m  | (c) 150.72 mm | (d) 53.38 km |
| 11 (a) 50.24 cm | (b) 62.8 m  | (c) 31.4 mm   | (d) 6.28 km  |
| 12 15.9 cm      |             |               |              |

### **ASSESSMENT**

Maths trail assignment.